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Post-mortem changes in morphology and its relevance to biometrical studies

by M. Herremans

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Post-mortem shrinkage in wing-length is well-documented (Barth 1967, Vepsäläinen 1968, West *et al.* 1968, Green & Williams 1974, Prater *et al.* 1977, Green & Greenwood 1978, Greenwood 1979, Green 1980, Knox 1980, Haftorn 1982, Bjordal 1983). Wing-length was found to diminish by from 0.39% in Willow Ptarmigan (West *et al.* 1968) to 3% in waders (Prater *et al.* 1977). There is less information available concerning the other standard measurements of birds. West *et al.* (1968) mention tail-shrinkage of 0.69%, but Bjordal (1983) found tail measurements to increase after specimens had dried. Bills have been reported to shrink by 1.6-5.4% in waders (Summers 1976) but no significant changes were found in Dunlins *Calidris alpina* by Greenwood (1979), nor in House Sparrows *Passer domesticus* by Bjordal (1983). Tarsus length did not change in Dunlin (Greenwood 1979), but diminished significantly in House Sparrows (Bjordal 1983). Vepsäläinen (1968), Kelm (1979) and Bjordal (1983) explained the discordance between results by stressing differences in methods of measuring, storing and preparation.

However, the real problem concerning the relevance of post-mortem changes to biometrical studies is not the significance of shrinkage traced on individuals, but to know if populations, predicted from measuring the sample before and after preparation, are statistically different. It will be shown here that the range of normal variation within a population is largely sufficient to buffer even the most significant post-mortem changes.

During the second Belgian expedition to the Comoro Islands, field conditions forced us to preserve some specimens by sun-drying after injection with concentrated formalin. Before taking these specimens into account in a comprehensive study on *Hypsipetes* (Pycnonotidae) (Louette & Herremans, in press), reliability of their measurements when compared to traditional skins was tested. A number of specimens of both *H. madagascariensis* and *H.p. parvirostris,* siblings with a very large overlap of dimensions (Benson *et al.* 1975) were remeasured after 10 months storage in the museum. Significance of difference was analysed using the "paired-sample t-test" when comparing these measurements to their corresponding life or freshly-killed original values. Difference between "fresh" and "museum" samples was tested using "analysis of variance" (ANOVA) on the same data.

TABLE 1

Biometry of the same *Hypsipetes* spp. individuals, fresh and after preparation and 10 months storage (all measurements in mm to 0.1 mm). Significance of difference (paired t-test) and comparison between samples (ANOVA)

	Individuals as fresh specimens	as museum specimens	Difference	Paired t-test	ANOVA
Maximum wing-chord N=36					
X	111.50	110.99	−0.51		
SD	4.46	4.30	0.57	t(df=35)=5.44	$F^{1}_{70}=0.24$
Range	100.5 – 120	99.5 – 118.5	−2.5 – +0.5	P<0.00001	P=0.62
Tail N=36					
X	92.44	93.51	+1.04		
SD	4.10	4.11	1.63	t(df=35)=3.83	$F^{1}_{70}=1.22$
Range	83 – 100.6	84.4 – 101.3	−2.6 – +4.3	P=0.00051	P=0.27
Tarsus N=44					
X	20.55	20.74	+0.19		
SD	1.18	1.24	0.39	t(df=43)=3.2	$F^{1}_{86}=0.54$
Range	18.3 – 23.2	18.6 – 23.5	−0.5 – +1.2	P=0.0026	P=0.46
Culmen to skull N=34					
X	25.80	25.74	−0.06		
SD	0.99	1.08	0.48	t(df=33)=0.75	$F^{1}_{66}=0.06$
Range	23.3 – 27.5	22.6 – 27.6	−1.25 – +1.45	P=0.46	P=0.81

Table 1 details descriptive statistics and results of analyses of the above specimens. The c. 0.5% shrinkage in wing-length is extremely significant and the c. 1% increase in tail and tarsus both constitute considerably significant changes. I agree with Bjordal (1983) that increase in tail length must be due to retraction of the skin between the rectrices and of the papillae themselves during drying; besides, it is a known phenomenon that calipers can be inserted deeper each time a tail measurement is repeated. Difference in tarsus length may be explained by the inability to apply exactly the same measuring procedure on a fresh and a dried-out leg, as also already explained by Bjordal (1983). Individual differences in response to post-mortem changes – stressed also by Greenwood (1979) and Green (1980) – are illustrated by ranges and standard deviations of the "Difference" column in Table 1. This relatively wide variation did, however, not substantially influence standard deviations of the museum sample.

Despite the 3 statistically significant post-mortem changes found, ANOVA proves that both fresh and museum samples must be considered identical in all measurements. Obviously, the rather large variations of the population (c. 15-25%), partly caused by sexual dimorphism, easily masks the comparatively small, but fairly consistent, post-mortem changes (0.5-1%).

If these data on formalin preserved *Hypsipetes* are found to be generalised, it seems there is no objection to using both museum and life measurements in one study at population level. When diversely obtained measurements of specimens of different preparations and duration of storage, including those of live birds, are used together, analysis may only show the disadvantage of decreased statistical discernibility by shortage of significance, due to increased variation within samples. Similar conclusions will probably be found when considering inter-operator differences in measurements.

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Abnormal numbers of tail feathers

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Occasionally birds have been found to have abnormal numbers of rectrices (Stresemann & Stresemann 1966, Hanmer 1981, Somadikarta 1984).* In some there was a pair of rectrices either missing or additional, but more often there were unequal numbers on either side of the tail. Hence I propose "anisorectricial" to describe tails with an abnormal number of rectrices, that is with a number that is unequal to the normal or with an unequal number on the 2 sides, as opposed to "polyrectricyly" (Somadikarta 1984).

*"Ed Mr Geo. A. Smith informs me that the oldest reference for an abnormal number of tail feathers may be the copper-plate engraving of the Carolina Conures *Aratinga (Conuropsis) carolinensis* of Audubon's (1827-38) *The Birds of America.* In *Ornithological Biography* (1831) he tells how the upper bird in the illustration, a female, had '. . . 14 Tail feathers all 7 sizes distinct and firmly affixed in 14 different receptacles . . .' and that he drew it '. . . to verify one of those astonishing fits of Nature . . .'."